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ABSTRACT

The use of computers as a tool for learning has traditionally focused on individualized methods of instruction. Social interaction, however, is taking an increasingly important role in current learning theories and instruction prescriptions including computer-based delivery systems. Concurrent with these recommendations, global computer networks have emerged bringing new forms of computer-mediated social interaction. This paper discusses an ongoing case study that takes advantage of Internet technology to promote learning through socially-mediated interactions. Based upon theories of situated learning and cognitive apprenticeship, students engage in social dialog with experts through Internet technologies such as e-mail, listservs, synchronous chats, and the World Wide Web. In this case, the experts were two multimedia developers, one academic and one corporate. They fielded questions related to the use of technologies for training from the class. (Contains 13 references.) (Author/SWC)

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Title:

The Internet as a Tool for the Social Construction of Knowledge

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Abstract

The use of computers as a tool for learning has traditionally focused on individualized methods of instruction (Lumsdaine & Glaser, 1960; Saettler, 1990). Social interaction, however, is taking an increasingly important role in current learning theories and instructional prescriptions including computer-based delivery systems (Bruffee, 1993; Lave, 1988). Concurrent with these recommendations, global computer networks have emerged bringing new forms of computer-mediated social interaction. This paper discusses an ongoing case study that takes advantage of Internet technology to promote learning through socially-mediated interactions. Based upon theories of situated learning and cognitive apprenticeship (Brown, 1989; Collins, 1990), students engage in social dialog with experts through Internet technologies such as email, email redistribution lists (listservs) and the World-Wide Web.

Background

The use of computers as a tool for learning has generally focused on individualized methods of instruction (Lumsdaine & Glaser, 1960; Saettler, 1990). Largely influenced by behaviorism, traditional computer-based training reflects a stimulus-response approach. Highly structured and repetitive interactions delivering immediate feedback are still standard features within many computer-based learning environments. Approaches derived from the cognitive sciences (such as Intelligent Tutoring Systems) have also featured individualized instruction (Farquhar & Orey, in press; Sleeman & Brown, 1982). With renewed influences from philosophy, sociology and anthropology, epistemologies and theories such as social constructivism and situated cognition suggest new approaches for the design and implementation of learning environments. Concurrent with the arrival of these new perspectives, technologies have emerged giving us new capability to engage learners in structured social interaction.

New Perspectives

Social constructivism posits that individual constructions of knowledge derive from interactions with the social environment (Cobern, 1993; Tobin & Tippins, 1994). From this perspective, knowledge is continually constructed and reconstructed by the individual. The social environment provides a set of experiences from which the individual tests understanding and adopts group norms. Viable learning environments, from a social constructivist viewpoint, structure social interactions to support the development of personal meaning.

This philosophical position is consistent with situated cognition, a theory that describes knowledge as a relationship between cognitive and social factors (Brown, 1989; Streibel, 1994). The primary supposition of situated cognition is that knowledge exists only within context. According to this theory, an understanding of knowledge must include the artifacts, activities, participants, and interactions within a cultural setting. Orey and Nelson (in press) suggest that the theoretical position of situated cognition is a cross-disciplinary perspective involving ideas from both psychology and anthropology. Lave (1988), an anthropologist studying situated cognition, describes the everyday use of knowledge as "distributed - stretched over, not divided among - mind, body, activity and culturally organized settings."

While social constructivism and situated cognition are views with which to understand and describe knowledge, cognitive apprenticeship is an amenable methodology for the acquisition of knowledge (Collins, 1990). The cognitive apprenticeship model proposes that the design of learning environments reconstruct important attributes of master-apprentice relationships. Among other attributes, "apprenticeship embeds the learning of skills and knowledge in their social and functional context" (Collins, 1990, p.454). Authentic tasks and meaningful situations are required to bring novices into a culture of expert practice (Brown, 1989; Vanderbilt, 1990). Thus, situated learning is a recognized and employable feature within the cognitive apprenticeship framework.

The cognitive apprenticeship model makes a number of recommendations for the design of learning environments. In addition to providing a meaningful and authentic task, the model calls for reflection, articulation, collaboration, and multiple practice. Cognitive apprenticeship prescribes the implementation of these features through structured social interaction within a community - a process that Lave describes as "legitimate peripheral practice." Until the recent development of the global network, structured social interaction has not been an instructional approach easily supported by computer technologies. The ongoing study described in this paper has examined the implementation of cognitive apprenticeship strategies through the use of recently-available Internet technologies.

Study Context

Over a period of four college semesters a variety of Internet technologies were implemented by the researchers in four separate graduate-level courses. All four courses were related to the topic of training technologies, yet had a different focus. The majority of the participants (75%; n=58) were completing introductory courses in training technologies, while the minority were taking development courses in either computer-based training (15%; n=12) or video production for training (10%; n=8). Upon entering the courses, few subjects had prior experience with Internet technologies. The fall and spring classes met for one evening per week, while the one summer course met twice per week.

The technologies selected to support the strategies included personal e-mail among participants, e-mail distribution lists (listservs), synchronous "chat" communications, and the World-Wide Web. Consistent with the cognitive apprenticeship model, the strategies implemented were characterized by:

Complex, problem-based scenarios were selected in order to situate or anchor knowledge within a variety of contexts.

Articulation was encouraged through open-ended requests to propose, posit, or recommend.

Reflection of personal experiences was encouraged through requests to defend and rationalize.

Responses to scenarios by all parties were most often "published" or made available for all in a socially-mediated, consensus-building environment.

Novices were encouraged to collaborate.

Data was collected through observations, records of electronic communications, interviews with selected subjects, and self-reports. This study, which continues through the present semester, intends to reveal how skill development can be supported or impeded by the strategies and technologies selected.

Procedure with Listserv & Email

The first technology implemented was electronic mail (e-mail) and an e-mail redistribution list (in this case known as a listserv). All students were given an e-mail account and a brief introduction to its use. A few students implemented e-mail capabilities from their home computer through either the University system or by subscribing to a commercial service.

All students were subscribed to a newly assigned listserv managed and controlled by the course instructor and lead researcher. Two special guests were regularly subscribed to the listserv with the specific responsibility to regularly respond to questions and comments as consulting experts in the field of training technologies. Brendan McGinty, now Vice President of Development & Operations with University Communications, has 20 years as a Computer-Based Training and Multimedia Developer. Carrie Kotcho serves Bell Atlantic as a Multimedia Developer and has 10 years of experience producing training videos and multimedia products. While introduced as "virtual guest speakers," the intent behind their participation was to include them as expert members of the community, or "mentors," to promote a cognitive apprenticeship relationship with classmembers.

Subscribers to the list were encouraged to introduce themselves and to post any messages that they felt relevant to the topic of training technologies. The two smaller classes were given specific assignments to introduce themselves to the list.

Assignments that involved use of Internet communications were characterized by an ill-defined problem, based-upon a real (or realistic) situation lacking in sufficient detail to render an immediate solution. Students were asked to propose a solution to the problem with the experts acting as either resources or clients. Figure 1 describes one of the given scenarios where Brendan McGinty, an expert in the implementation and application of the NovaNET CBT system, acted

as a mentor. In most cases, teams were formed (from two to four students) to worked on problems with the request that they post all questions and responses to the list.

Results from Listserv and Email

The teams collaborated for a period of typically less than one hour before generating and posing questions for the expert. While the request was made to post all questions to the listserv, a few teams sent questions directly to the expert through his e-mail address. Reported reasons for this were both a misunderstanding of the directions as well as inadvertent or an unintended use of the e-mail system.

Nearly all questions posed by the students at this early stage of the assignment were lengthy descriptions of the problem. Most of the postings to the listserv were summaries of the given scenarios; one team simply copied the given problem description to the listserv with an additional question at the end.

With minor exceptions, the students reported that the problems were meaningful and relevant. On more than one occasion, a team admitted to intentionally forming some assumptions of the problem around their own work-related context or present need. Upon consultation with the instructor, one team generated their own problem directly from their present work environment.

Engineering Services Scenario:

A company providing a broad range of engineering services with headquarters in Raleigh-Durham, North Carolina, is dedicated to maintaining a highly-educated workforce knowledgeable in current technologies. The headquarters provides offices for 120 mechanical, electrical, and computer-science engineers. An additional 25 personnel are employed in managerial and support staff roles. Nearly all employees have a college degree, many posses graduate degrees.

The company boasts its support for the personal growth of its employees. Nearly all of its employees use computers in their daily activities. Computers are assigned to each employee and a number of regular workshops are offered in various software applications. Most company computers are high-end systems capable of running sophisticated modeling programs and are connected to various networks including the Internet.

The company requires that each employee complete 40 hours of training and development programs each year. Employees select programs through consultation with management. The majority of training programs provide employees with an opportunity to increase their engineering skills in a particular area or to broaden their skills to other areas. Unfortunately, the present training facilities are overbooked and understaffed. Many employees are waiting six months or more to schedule some of the more popular courses.

This company is seeking to expand its training programs, but is looking at cost-effective alternatives to simply providing additional training staff and space. So far, the company has not made use of CBT as a delivery medium. Would you advise the company to provide CBT? And, what services, if any, from NovaNET would you recommend that they provide?

Figure 1. Example problem for listserv discussion.

Responses from the experts to the initial set of questions occurred anywhere from one to five days later. The responses were most often lengthy discussions presenting several points. Since all responses to the questions were posted to the listserv, the experts would often refer to points made in their previous comments.

A couple of teams were able to develop their solution to the problem after only one interchange with the expert. Other teams, however, asked follow-up questions approximately one week later. On very few occasions did the dialog continue through three rounds of questions and answers. The lack of follow-up dialog through more than a single round of

questioning was consistent in most dialogs on the listserv despite the researchers' intent, through on-line encouragement, to "keep the questions coming."

In class, students reported a respect for the experts and the information provided for them through the listserv. Additionally, students reported an interest in continuing a dialog with the experts with a few comments suggesting that the listserv dialog was "very short."

Procedure with Synchronous Chat

One small class (n=8) during the summer of 1995 was engaged in synchronous chat sessions with an expert centered on solving an ill-defined problem. In most cases, students were asked to propose a training video as the solution to a particular training problem. The chat was arranged through a commercial on-line service (America Online) due the availability of such service by the expert. The interface for the synchronous chat allows messages of no more than two lines to be immediately posted within a scrolling window.

Pairs of students were formed to respond to the expert's questions. Each pair was advised to collaborate on the problem prior to meeting the expert on-line. Some students were given a particular time and location for the chat, while other students who had subscriptions to America Online were left to arrange a time with the expert at their convenience.

Results with Synchronous Chat

The pairs collaborated for times ranging from 30 minutes to one-and-a-half hours, often immediately before their scheduled chat time. In all observed cases, one student from each pair took control of the keyboard for the 30-minute, on-line dialog. With other issues, a variety of approaches to the chat technology were observed. A few students typed many lines of background information before any interchanges with the expert took place. Others would address a point at a time, or would simply respond to questions placed by the expert.

Sentences, or single ideas, were quite often broken into several entries, obviously in response to the limitation of the interface. And, due to the time delay in posting these two-line responses, the order of display would not reflect the order of conversation. Figure 2 is an example dialog with this characteristic.

Expert:	I have produced Hazardous Communications videos and videodiscs for several companies
Expert:	but usually they are only concerned with labelling and safety gear. What are the objectives
Pair3:	Well then, I would not have to have spent so much of my precious time learning this editing equipment
Expert:	of this video.
Pair3:	and producing this video.
Pair3:	Employees will be able to have acces and know how to read MSDS sheets...

Figure 2. Example synchronous dialog.

This characteristic appeared to confuse both the novices and the expert when significant thoughts were left apparently incomplete until many moments later. The trailing notes caused students to re-read earlier entries in order to follow the stream of the dialog.

Without exception, students reported a high interest in the novelty of the chat technology. They also were so interested in physically meeting the expert, that the class took a road trip of 1.5 hours later in the semester to meet her.

Procedure with World-Wide Web

We are just beginning to use the World-Wide Web as a medium of social dialogue. While course materials for these classes have been provided on the web for over a year, the materials are generally information only and do not lead to dialog. Social discourse through the Web is being implemented in small ways; we have plans to implement more social discourse in the future.

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Presently, some questions related to the personal experiences, expectations, and contexts of the course are being asked of students. Students respond through a web page with fields or "forms". The responses get posted to the web site for the course for all other students to browse. Figure 3 is an example of one the questions posed through the web.

Personal and job-related context related to this course.

Many individuals who take this course have a computer and other resources already available to them. In addition, some individuals have an immediate need for computer-based training products at their place of employment. In order to improve our understanding of your context, please respond to the following questions.

- I have personal access to a computer for use with this class.
- I have Internet access from my personal computer.
- I have or will have personal access to the ToolBook authoring system.
- I have a project already selected for development.
  (Project description and context):
- For this course I'd like to convert, some portion of my Internet course to a multimedia format, and have it available on the Web...

Figure 3. Example Course Questions Posted to the Web

We have proposed additional software to take advantage of the multimedia and global networking capabilities of the web. The proposed software will provide instruction and support in the domain of performance technology. Users will investigate industry-related performance problems (e.g. production errors, complaints, low production) by conducting "interviews" and recommending solutions (e.g., provide training, increase rewards, remove obstacles.)

Students enrolled in courses at Penn State Harrisburg will be solicited for participation as well as students in similar programs at other institutions. Recognized experts and trainers in the field will be especially encouraged to participate.

Conclusions

It was the intention of the study to implement Internet technologies in ways that support and promote cognitive apprenticeships. In the opinion of the researchers, this was not fully realized. One central component of the cognitive apprenticeship model is multiple practice within the domain. The strategies implemented in this study failed to demonstrate a form of multiple practice that we expected to see in social discourse. We are calling this feature dialog momentum.

Dialog momentum is demonstrated by the continuance of a discussion upon an idea through several rounds of responses. It is best represented in electronic communications through threads of discussions with multiple listserv postings and personal correspondence. This feature was not well demonstrated in this study.

Both the listserv activities and the synchronous chat activities did not demonstrate dialog momentum to our expectations. Listserv discussions did not, on the whole, demonstrate multiple postings concerning single topics. Instead, discussions revolved around only a few postings. Within the chat feature, dialog certainly did consist of multiple responses. However, the disjuncted nature of the dialog meant that one had to constantly move backward, not forward in the discussion.

One of the major reasons that dialog momentum did not occur in the listserv, in the opinion of the researchers, is the result of the context of the study. Most participants had access to electronic mail only once per week as they attended their weekly class. Dialog momentum requires a faster turnaround of responses. Additionally, the synchronous chat session would have been greatly improved by faster response times. Slow communication response times was the major obstacle to moving the dialog forward.

In summary, present Internet communications such as listservs and synchronous chat sessions can be used to support instructional purposes. The use of on-line experts can aid the process by providing additional resources and points of view. True cognitive apprenticeships which require repetitive practice through the notion of dialog momentum are difficult to accomplish. More attention toward creating dialog momentum may deliver better results.

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